Suggested Groundwater Modeling Process

Applicants should follow standard accepted modeling practices. EPA, State, and Applicant should communicate frequently to discuss any concerns as early as possible.

**Step 1: EPA Provides Modeling Goals**

- Brief letter specifying modeling goals
- Example Goal 1: Based on a calibrated groundwater flow model, determine the area of influence of all drinking water wells in model domain to steady-state conditions (equilibrium) given all known local and regional hydraulic stresses on the groundwater system.
- Example Goal 2: Based on the groundwater model from goal 1, determine whether any groundwater currently within the proposed exempted area will reach any currently operating drinking water well inside the model domain over the total anticipated average lifespan of such wells.
- Example Goal 3: Using fate and transport modeling, if possible, determine whether projected contaminant concentrations at proposed exemption boundaries and at any affected drinking wells exceed MCLs during: (i) the life of the mine, and (ii) during the anticipated average lifespan of drinking water wells.

**Step 2: Applicant Develops Workplan/Quality Assurance Project Plan**

- Can be a single document; provides project scope and modeling methods
- Can format after EPA QA guidance (EPA QA/G5-M) for models
- Submit to EPA and State; review for calibration targets, data sources, quality, etc.
- QA for fate and transport may include checks with various analytical models and calculations using advection and dispersion equation (as in Fetter and other texts), as necessary.

**Step 3: Applicant Develops Conceptual Model (written description of site characteristics)**

- Use existing information and new information if necessary
- Should contain tabulated data for computer model input files; describe model design
- Submit to EPA and State; review setup, site representation, boundary conditions, etc.

**Step 4: Applicant Performs Computer Modeling**

- Perform iterations as necessary, adjustments to input, additional runs
- May need to submit to EPA and State; review model execution, input/output

**Step 5: Applicant Prepares Report**

- Submit to EPA and State; review calibration, sensitivities, modeling uncertainties, etc.
- Each goal should be discussed separately including the degree to which each goal was met for 40 CFR Part 146.4(a). EPA prepares response.

** Note: If analytical models are used (with appropriate justification) steps can be revised as needed.

Selected Resources for Standard Modeling Practices

- ASTM D-5447: Application of a Groundwater Flow Model to a Site-Specific Problem
- ASTM D-5718: Documenting a Ground-Water Flow Model Application
- ASTM D-5609: Defining Boundary Conditions in Ground-Water Modeling
- ASTM D-5610: Defining Initial Conditions in Ground-Water Modeling
- ASTM D-5611: Conducting a Sensitivity Analysis for a Ground-Water Flow Model Application
- ASTM D-5490: Comparing Ground-Water Flow Model Simulations to Site Specific Information
- USGS: Guidelines for Evaluating Groundwater Flow Models, 2004-5038.

Other Resources

- EPA 540-R-96-003: Documenting Groundwater Modeling at Sites with Contaminated and Radioactive Substances
- EPA 402-R-94-012: A Technical Guide to Groundwater Model Selection at Sites With Contaminated Radioactive Substances
- EPA QA/G-5M: Guidance for Quality Assurance Project Plans for Modeling

The following information will probably be necessary to complete fate and transport modeling.

- Source area concentration
- Fraction of organic carbon
- Carbon-water sorption coefficient
- Soil (geologic material)-water sorption coefficient
- Downgradient distance to nearest receptors
- Hydraulic conductivity
- Hydraulic gradient
- Average linear velocity
- Width of source area parallel to groundwater flow
- Total porosity
- Soil material bulk density
- Saturated thickness
- Storativity (storage coefficient)
- Infiltration rate of water through soil (recharge)
- Longitudinal dispersivity
- Transverse dispersivity
- Vertical dispersivity
- Degradation rate
- Time since release

*(Source: RBCA Fate and Transport Models Compendium and Selection Guidance, ASTM-EPA, November 1998).*